

**COMPREHENSION OF RAPID SPEECH BY THE BLIND,
PART II, SEMIANNUAL REPORT**

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Comprehension of Rapid Speech by the Blind: Part III

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The "rapid speech" project, as now organized, is conducted by the principal investigator, two graduate students serving as research assistants, and an electronics technician. Weekly meetings are held during which problems are identified and defined, research strategies are developed, and work assignments are made. These meetings are also attended by graduate students who are interested in this area of research. One such student is now developing a research problem that will provide the basis for his doctoral dissertation. The experiments that have been planned and initiated during these weekly meetings will be presented in the following sections.

The Comprehension of "Rapid Speech" After Prolonged Exposure. In our research to date, we have not been able to demonstrate an improvement in the comprehension of "rapid speech" with training. There appears to be an initial, small practice effect that is realized during the first few minutes of listening. Beyond this, we have not been able to show that additional exposure results in better comprehension. However, this conclusion is based only upon the test performance of those individuals who have participated in our formal training programs. These subjects have, at the most, been exposed to only eight or ten hours of "rapid speech". The informal and uncontrolled experience of those of us who have been working on the project for several years suggests that much longer exposure may result in an improvement in the ability to comprehend "rapid speech".

One problem encountered in the previous training attempts has been that of motivation. In retrospect, we feel that our subjects were not sufficiently motivated. Their participation was compulsory, we made demands on their time over a period of several weeks and their performance during training had no bearing upon their school grades.

For these reasons we are conducting a training program involving blind school children who read extensively by listening for recreational purposes. They read because they like to read, and not just because their teachers require them to. We have identified nine such children at the Kentucky School for the Blind ranging in grade from the fifth to the twelfth and in age from 10 to 18. We will provide for each subject tape recorded books at accelerated word rates. Although our library of titles is limited, each subject will be permitted to choose books according to his own interest. The word rate at which a particular book is prepared will depend upon an assessment of the subject's current ability to comprehend "rapid speech". Initially, word rates will be only slightly faster than normal. However, as a subject gains experience with "rapid speech", his word rate will be increased gradually. The final word rate will depend, in each case, upon the progress shown by the subject.

Two objectives are sought in this project. The first is the determination of the effectiveness of prolonged, motivated listening to "rapid speech" as a training procedure. To evaluate this approach, one form of the STEP listening subtest was administered to the listeners before they commenced their reading program. They will receive an equivalent form of the STEP listening test upon completion of their reading program, and a comparison will be made between pre- and post-training listening test scores.

The other objective is an actual demonstration of the applicability of "rapid speech" at its present state of development. Our experience to date

indicates that, without special training, listeners can show good comprehension of material presented aurally at around 275 words per minute. This rate is enough faster than the normal oral reading rate of approximately 175 words per minute to constitute a significant savings in reading time. Upon conclusion of this training program, there will be several readers who have listened to several books at accelerated word rates. Even if no training effect can be shown, the experience of these readers will help us to make a decision regarding the value of "rapid speech" as a method for presenting written information to blind listeners.

The Intelligibility and the Comprehension of 'Rapid Speech'. We know that beyond approximately 275 words per minute, comprehension, as indicated by performance on multiple-choice tests of listening selections, begins to fall off rapidly. However, we do not yet have a convincing explanation for this loss. Two alternative explanations seem plausible. One is in terms of central and one in terms of peripheral factors.

To pursue this matter further, we have distinguished between intelligibility and comprehension. If a listener can repeat, without error, an aurally presented sentence that is formed from short, familiar words, and that is short enough to fall well within his immediate memory span, the speech he has heard is intelligible to him. On the other hand, comprehension is demonstrated to the extent that the listener can show, upon subsequent testing, a mastery of the content and organization of a listening selection.

We are now preparing materials appropriate for both kinds of presentation. We plan to conduct an experiment in which intelligibility and comprehension will be determined at several accelerated word rates. The comparisons afforded by this experiment should clarify the contribution of peripheral and central factors to the difficulty in understanding accelerated speech, and thus guide future inquiry.



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An Examination of the Relative Distortion of Various Speech Sounds as a Function of the Amount of Speech Compression. In another effort to find out why "rapid speech" is difficult to understand, we plan to examine the distortion of initial, middle, and final consonantal and vowel sounds. The method of speech compression employed in our investigations increases word rate by regularly eliminating very brief segments of tape-recorded speech. Ideally, word rate is increased without any other change in the message quality. However, there is some distortion and this distortion may be selective with respect to the various speech sounds.

To explore this possibility, we have chosen words from the published lists of phonetically balanced words for inspection. In one approach, we prepared several tapes, each of which contained a sequence of increasingly compressed recordings of a single word. In listening to these tapes, we could gain an impression of the extent to which distortion was introduced as the amount of compression was increased.

There was a strong suggestion of selective distortion as the amount of compression was increased. Initial consonants often appeared to be dropped and initial vowel sounds were sometimes markedly affected. For instance, at around 50% compression, the word "use" began to sound like "hues".

To get an impression of the variability in distortion that results from repeated compressions at a given per cent, several tapes were prepared, each containing a large number of compressed recordings of a single word, with the amount of compression held constant.

It was apparent from listening to the speech compressor's successive reproductions of a word that there was considerable variability. Some reproductions were of high quality. In others, there was a modification or loss of some speech sounds. This variability was probably produced by differences in the

way in which the word was sampled on successive reproductions by the speech compressor. The signal quality of the type of speech compressor we are using is, in part, a function of the length of word segments that it discards. If these segments are short enough, their absence will not be detectable by the listener, and they will be enough shorter than the speech elements of brief duration so that no speech element will ever be lost or modified. Our findings suggest that this requirement is not completely met with the equipment we are using.

So far, our findings are based only upon the impressions gained by listening. However, we have now made plans for the spectrographic analysis of samples of recorded speech prepared in the manner described above. Ultimately, we hope by this means to carry out an analysis of the intelligibility of compressed speech in terms of the selective influence of speech compression upon the various speech elements, and the relative contribution of the various speech elements to the intelligibility of the English language.

The Use of Filtering to Improve the Intelligibility of Compressed Speech.

Some research indicates that the intelligibility of speech may depend, in part, upon the distribution of energy in that portion of the audible spectrum required for the transmission of speech sounds. If this is true for normal speech, it should be true for compressed speech as well. Therefore, we plan, by frequency-selective filtering of the output of the speech compressor, to shape its response curve in various ways and to judge the influence of such shaping upon the intelligibility of compressed speech. If, as a result of this pilot work, we find that the intelligibility of compressed speech seems to be improved by certain filtering arrangements, we will conduct experiments to test these impressions.

Compressed Speech Viewed as a "New Language". As the amount of speech compression increases, the resemblance between compressed and normal speech

decreases. If this resemblance is too slight, the compressed speech will be unintelligible. However, it may be that a listener can learn to recognize compressed speech sounds just as he has learned to recognize the sounds that make up normal speech. This learning may not take place merely by listening to passages of compressed speech. In order for connected speech, at a very fast rate, to be intelligible to a listener, he may first need to learn to identify individual words and then phrases that have been highly compressed.

In accordance with this line of reasoning, we are now preparing the materials for a study in which a small group of subjects will be given practice in the recognition of highly compressed common words. When they have mastered this task, they will be given phrases and then sentences formed with these words. Training of this sort will be continued until they have acquired sufficient "compressed vocabulary" to permit useful communication. It is hoped that training of this sort will make possible the comprehension of very rapid speech, e.g., 450 or 500 words per minute.

A Survey of the Reaction to "Rapid Speech". In cooperation with Recording for the Blind, we are conducting a survey of RFB readers to gauge the response to "rapid speech" of people who read by listening. Samples of "rapid speech" have been recorded on the 7-inch plastic discs, used by RFB for recorded texts. The record includes samples of material read by different readers at several accelerated word rates. These records, together with appropriate questionnaires, have been sent to the 100 members of a sample drawn from RFB's list of subscribers. We hope the analysis of responses to this questionnaire will help us make a more informed guess about the kind of material and the amount of compression that would be acceptable to people who read by listening.

Because of the experience we now have with "rapid speech" we feel relatively secure in asserting that speech which, though only moderately compressed, is

compressed enough to produce a significant savings in listening time, can be understood without special training. If listeners will accept such speech, it can be used today.

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